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Small Grain Seed Treatment Guide

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Seed treatments promote seedling establishment, ensure yield and reduce quality losses due to many diseases and insects. The ability of seed treatments to control many fungal diseases has made them one of the biggest success stories of plant disease control. For instance, seed-borne smuts historically caused tremendous yield and quality reductions in grain-growing regions worldwide. Use of effective seed treatments has reduced the severity of many smuts to the point that their occurrence is now rare. However, smut problems may re-emerge if seed treatments are abandoned.

Seed treatments control fungi residing on the seed surface or inside the seed and are effective against pathogens that reside in the soil and cause seed rots, damping off and root rots. Most seed treatments do not control bacterial pathogens and none control seed-borne viruses.

Insecticidal seed treatments have been used for years to prevent seed and seedling damage caused by some soil-inhabiting insects. Recently the development of systemic seed treatments with residual activity provides post-emergence protection against insects such as aphids. A decade ago, producers had relatively little choice in available seed treatments. However, several new treatments with a diverse spectrum of activity, plus numerous products with combined active ingredients now are registered for use on small grains. In addition to being one of the least expensive and safest methods of chemical pest control, seed treatments are more specific and effective against a wider range of diseases and insects than in the past.

Guidelines for choosing a seed treatment

The intention of this publication is to compare the effectiveness of available seed treatments on diseases and insects that affect Montana small grains. While seed treatments often are a very important pest management tool, it is best to develop a long-term plan involving a spectrum of pest management practices. Seed treatments, resistant varieties, crop rotations, residue and volunteer management, adequate soil fertility, monitoring and other pesticides are just a few management variables that can influence disease/insect problems. **Careful consideration of all management options available for recurring pest problems is important.**

The recent registration of Dividend®, Raxil®, Maxim® and Gaucho® as well as the availability of other products with combined active ingredients gives producers a much greater choice in available seed treatments than ever before. Before selecting a product, producers should determine which diseases and/or insects, have been recurring problems in their location. County MSU Extension

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agents can aid in identifying pest problems and provide information on the common pest problems in specific areas of the state. Producers can then **choose a product based on comparisons of product activity against organisms of concern.**

It is always important to **start with very good quality seed.** Examine seed lots carefully before purchase or when using stored seed. A seed laboratory can conduct standard seed quality tests at a low cost. Seed lots with low test weights, low germination rates or discolored kernels often produce less vigorous plants, even when this seed is treated. Damaged seed may be further damaged by chemical seed treatments. Seed treatment dosage and environmental conditions also affect the ability of seed treatments to control target diseases and insects. **Using recommended rates and minimizing environmental stresses through good management practices will maximize the benefits of any seed treatment.** Because some seed treatments may become less effective over time, plant seed as soon as possible after it is treated.

Types of seed treatments

There are two main categories of seed treatments—protectant (contact) and systemic. Protectants help control pathogens that reside on the seed surface. In contrast, systemic seed treatments control seed-borne fungi that reside within the seed or infect the seed surface. Some biological agents with protective activity also show promise for pest control.

Cautions

Since seed treatments are poisonous, it is important to follow label directions when applying these chemicals and when handling treated seed. Some products are toxic and others are irritating to the skin and respiratory system. Regardless of the product, use of protective clothing, gloves, an approved chemical respirator and goggles are recommended.

Combinations of some fungicidal and insecticidal seed treatments can be toxic to the seed. **It is important to read the label carefully before mixing insecticides with fungicides.**

Generally, commercial facilities use liquid concentrate or flowable formulations while drill box treatment involves use of powder or dust formulations. **Either method requires uniform coverage of the seed at the recommended rate for good disease control.** Lower rates may not give adequate control, whereas higher rates may cause seed injury.

Treated seed should never be used as food. In addition, equipment such as augers and trucks used to deliver grain to elevators should not be contaminated by treated grain.

Diseases

Common bunt of wheat

Common bunt also is known as stinking smut, because its presence on the head causes a pronounced odor of dead fish. This disease is the most common smut observed in Montana wheat. The spores that carry the disease from one growing season to the next occur on the seed surface and sometimes in the soil. While common bunt no longer is a serious production problem, researchers confirmed that in 1997, two percent of Montana's wheat carried background levels of this pathogen. Without seed treatments, the disease again could become an economic problem. Late planted winter wheat is most prone to infection. With the exception of imazalil, a number of protective and systemic materials provide good control.

Covered smut of barley

Covered smut differs visibly from loose smut in that a mass of black spores develop within a semi-persistent membrane in place of the kernels. Harvest of infected grain with healthy grain results both in yield and quality losses. Use of effective seed treatments can prevent yield losses due to covered smut. Covered smut can be soil-borne, but it is more commonly seed-borne. The fungal spores reside directly on the seed surface or under the hull of the barley kernel. Most surface-acting seed treatments result in elimination of spores on the seed surface.

Loose smut of wheat and loose smut of barley

Although two different pathogens cause loose smut of wheat and barley, these organisms act in a similar manner on both crops. Spikelets on infected plants normally become transformed into a dry mass of dark spores enclosed in a delicate membrane. This membrane ruptures easily, and the spores blow away, leaving only a barren head stalk (naked rachis) remaining. The windblown spores enter the flowers of developing heads. Both pathogens then invade the seed germ or embryo. The development of the fungus **inside** the new kernel makes protective fungicides ineffective for control. Neither smut disease is serious when seed treatments are used. However, the forage barleys are extremely susceptible to loose smut. Therefore, **forage barley seed always should be treated with an effective systemic fungi-**

cide such as Raxil® or one containing carboxin. Interestingly, Dividend® does not control loose smut in barley, but provides effective control in wheat. If low levels of loose smut occur in grain to be saved for seed, that seed should be treated with an appropriate systemic fungicide.

Dwarf bunt

Dwarf bunt is a disease of winter wheat that can develop wherever snow exists for prolonged periods on unfrozen ground. Depending upon temperature, the infection process requires anywhere from 35 to 105 days for completion. Dwarf bunt occurs in scattered areas of western and central Montana. In the past, available seed treatments have been ineffective in controlling this smut, and use of resistant varieties or very late seeding have been the main controls used. However, Dividend® provides complete control of dwarf bunt when used at the highest recommended rate. This fungicide has expanded the number of varieties available to Montana grain producers in affected areas.

Dry seed decay

In dry years, many producers seed winter wheat into very dry soils and wait for moisture to stimulate seed germination. Dry seed decay is most common in northern Montana, although the disease is not limited to this area. Symptoms include the growth of a blue or green mold *(Penicillium)* on the seed. Reduced germination potential and poor stands result. Unless prolonged dry soil conditions persist in the spring, dry seed decay seldom is a problem on spring wheat. Seed treatment with imazalil (FloPro IMZ®, Nu-Zone®, Double R®, Vitavax Extra®) provides excellent control of this disease.

Common root rot

This is a soil-borne fungal pathogen that attacks the subcrown internode of plants grown **under stress,** especially moisture stress. Actual losses vary from trace amounts to five to six percent. Evaluations of seed treatment trials indicate that some fungicides are effective in reducing root rot severity, but a corresponding yield increase does not always result. The conditions in which seed treatments are likely to be beneficial are: where the causal fungus is abundant in the soil, under continuous small grains or small grain-summer fallow cropping systems, or in soils or locations with low growing season moisture. This disease is commonly associated with *Fusarium* crown rot.

Fusarium crown rot

This is also a soil-borne fungal pathogen that attacks the crown system of plants grown under moisture stress conditions. The loss of crown roots and the associated crown tissue can result in yield losses up to 20 percent. Evaluations of seed treatment trials indicate that some fungicides are effective in reducing root rot severity, but a corresponding yield increase does not always result. The conditions in which seed treatments are likely to be beneficial are: where the causal fungus is abundant in the soil, under continuous small grains or small grain-summer fallow cropping systems, or in soils or locations with low growing season moisture. Conditions which encourage abundant early season growth, such as high moisture or over-fertilization with nitrogen, followed by a hot dry period, will deplete the available soil moisture and promote disease development. This disease is commonly associated with common root rot.

Take-all

Take-all is a devastating disease that has defied control for over 100 years. Symptoms include patches of bleached plants with unfilled heads. Plants pull easily from the soil, and the root system is poor with shiny, coal-black roots and crowns. This fungal disease is indigenous to native prairie grassland soils at low levels. In Montana, take-all is most common in irrigated wheat fields. However, the disease also may occur in dryland fields in years of heavy rainfall in the spring and early summer. When combined with moisture, the following conditions also are favorable to disease development: high soil alkalinity, low fertility (especially nitrogen and phosphorous), soil compaction, cool weather, early-seeded winter wheat, and continuous wheat for two to five years. In irrigated fields with a history of take-all, Baytan® provides good to variable suppression of the disease for four to six weeks of plant growth. However, late-season control and yield responses have been variable in Montana. No available product provides complete control of take-all.

Seed-borne scab and Fusarium scab

Although the same organisms cause both seed-borne scab and *Fusarium* scab, these are two entirely different diseases. *Fusarium* scab infects plants at flowering and causes bleaching of the heads and powdery-white, shriveled kernels that often contain vomitoxin, which is toxic to livestock, especially swine. If seed infected with *Fusarium* scab is planted, a seedling decay known as seed-borne scab can develop. This disease results in a poor stand. Seed from fields planted in corn the year

before the seed crop of wheat was produced are more likely to have seed-borne scab problems. However, *Fusarium* scab can be a problem in small grains regardless of the rotation if environmental conditions at flowering allow scab to develop in the heads. In years after *Fusarium* scab is severe, it is important to make seed purchases early for the next growing season since quality seed may be in demand. Cleaning and use of an effective seed treatment is important in seed lots containing even low levels of scab. Vitavax Extra® and Maxim® provide excellent control of this disease.

Wet soil seedling rot (caused by Pythium)

The soil-borne fungus *Pythium* can cause pre- or post-emergence damping-off of wheat and barley seedlings. Symptoms include poor stands and/or patches of young plants that are pale green in color and stunted. Roots of young plants may have soft, wet, tan-brown areas at or near their tips. Older plants are not affected by *Pythium* disease. *Pythium* can be most damaging when small grains are planted in dry soil that is then soaked by rain or irrigation. When the soil first becomes wet after a dry period, nutrient levels released from the seed and soil are high, and competition from other soil organisms is low, thereby favoring *Pythium* infection. Problems also are more likely in soils prone to crusting. While wet soil seedling rot is not common in most areas of Montana, this disease does occur in scattered locations under favorable conditions. In problematic locations, the systemic seed treatment Apron® can protect against the damping-off stage. Since the activity of Apron® is limited to *Pythium* and related fungi, it should always be used in combination with materials active against other pathogens. Broad spectrum products, such as maneb and thiram, provide some *Pythium* suppression, but are less effective than Apron®.

Rhizoctonia (the cause of bare patch)

The pathogen *Rhizoctonia solani* can cause a root rot disease in small grains. Symptoms occur most prominently in the early season. Varying sized patches of plants become severely stunted, and the seminal and crown roots of infected plants have distinct sunken, brown lesions and “spear-tipped” roots. The disease sometimes occurs in minimum- and no-till systems that allow the pathogen to survive on intact residue and volunteer. In Montana, *Rhizoctonia* also has been a problem in conventional tillage fields where large amounts of either volunteer wheat or cheatgrass were sprayed with glyphosate and subsequently seeded to small grains within one to seven days. The evaluation of systemic seed treatments suggests that they can suppress *Rhizoctonia* development. However, correct volunteer management and delayed seeding intervals remain the preferred control method for this disease.

Barley stripe

Barley stripe has occurred sporadically in Montana since the 1980s. An internally seed-borne fungus causes this disease, and it should not be confused with the viral disease, barley stripe mosaic. Symptoms include yellow striping of the leaves that progresses to necrotic brown streaking. Irrigation or high moisture conditions are necessary for seed infection to occur. Without this moisture, barley stripe seldom is a problem. Seed treatments containing imazalil provide excellent control of barley stripe. However, unless the disease is known to occur in a crop to be used for seed, seed treatments are unnecessary.

Net blotch of barley

This foliar disease of barley is known to be seed-bone. Tests at Montana State University revealed that up to 36 percent of seed in certain lots were infested with net blotch. The use of imazalil was effective in suppressing this seed-borne inoculum. However, in fields with heavy barley stubble, infection of new plants also commonly originates from inoculum residing on the residue.

Loose smut of oats

Unlike most loose smuts, this particular disease can be controlled by either a systemic or protective seed treatment. While generally not serious in Montana, a few isolated oat fields experience loose smut each year. Seed treatment is recommended if seed from infected fields will be saved for future planting.

Insects

Wireworms

These soil-inhabiting insects cause sporadic and sometimes severe stand reduction in wheat, barley and other crops. Damage varies from feeding injury shortly after plant germination to stem clipping shortly after plant emergence. Damaging wireworm populations are difficult to predict since, in Montana, there are several species with life cycles varying from one to seven years. However, the use of bait stations for monitoring wireworm populations has been somewhat effective for estimating field infestation levels.

Damage is more severe when spring weather is cool and wet. Most producers routinely treat their seed to minimize potential stand loss, especially in locations with a previous history of wireworm feeding injury. Lindane is an effective and relatively inexpensive seed treatment that producers have used for many years. Gaucho® and Lorsban® are approved for use to control wireworms, also.

Aphids

Russian wheat aphids have caused significant crop losses in Montana small grains. Other aphids, including the oat-bird cherry aphid, English grain aphid and greenbug aphid, do occur in Montana and are common vectors of barley yellow dwarf. This viral disease has caused sporadic but serious losses in both winter and spring grains. Generally, barley yellow dwarf is most serious in early-seeded winter wheat. Gaucho® and Di-Syston® have been registered for use against the above aphids. In situations where severe infestations are likely to occur (such as in spring seeded grain), seed treatment provides protection against these aphids for several weeks. The higher registered rate can be used if extreme aphid pressure is expected. Because aphids migrate into Montana during the growing season, regular monitoring to detect their presence and estimate populations is recommended. When Russian wheat aphid populations reach or exceed the economic threshold, a foliar treatment may be applied (refer to High Plains Integrated Pest Management Guide for Colorado, Western Nebraska, Montana and Wyoming, Bulletin 564A. Available from Colorado State University Extension Service, 970-491-6198).

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This information is for educational purposes only. Reference to commercial products or trade names does not imply discrimination or endorsement by the Montana State University Extension Service.

Table 1. Registered small grain seed treatments.

Manufacturer	Trade Name	Common name of fungicide/insecticide (% active)
Agsco	Apron XL	metalaxyl (32.3)
	DB-Green dry	maneb + lindane (50+18.75)
	DB-Green liquid	maneb + lindane (25.6+8.6)
	DB-Green + Double R	maneb + lindane + imazalil (25.6+8.6+10)
	DB-Green + Vitavax	maneb + lindane + carboxin (25.6+8.6+34)
	Dividend 3 FS	difenoconazole (32.8)
	Dividend XL RTA	difenoconazole/metalaxyl (3.21+0.27)
	Double R	imazalil (10)
	Maxim	fludioxonil (40.3)
	Vitavax 34	carboxin (34)
	Vitavax 200	carboxin + thiram (17+17)
	Vitavax Extra RTU	carboxin + imazalil + thiabendazole (16.7+1.2+1.5)
	Vitavax Thiram RTU	carboxin + thiram (10+10)
Gustafson	Allegiance FL	metalaxyl (28.35)
	Apron FL	metalaxyl (28.35)
	Apron XL FS	metalaxyl (32.3)
	Apron 50W	metalaxyl (50)
	Baytan 30	triadimenol (30)
	Baytan – Thiram RTU	triadimenol + thiram (5+15.3)
	Captan 30 DD	captan (28.7)
	Captan 400	captan (37.4)
	Di-Syston	disulfoton (95)
	Flo-Pro IMZ	imazalil (31)
	Gaucho 75 ST	imidacloprid (75)
	Gaucho 480	imidacloprid (40.7)
	Gaucho XT	imidacloprid + tebuconazole + metalaxyl (12.7+0.62+0.82)
	Kodiak	*Bacillus subtilis* biological fungicide (2.75)
	Lindane 30C	lindane (30)

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Table 1. Registered small grain seed treatments (continued)

Manufacturer	Trade Name	Common name of fungicide/insecticide (% active)
Gustafson (cont.)	Lorsban	chlorpyrifos (30)
	LSP	thiabendazole (30)
	Raxil 2.6 F	tebuconazole (28.3)
	Raxil - Thiram	tebuconazole + thiram (0.6+20)
	Raxil XT	tebuconazole + metalaxyl (15+20)
	Raxil MD	tebuconazole + metalaxyl (0.48+0.64)
	Rival	captan + PCNB + thiabendazole (19.8+8.4+1.0)
	RTU	Thiram + thiabendazole (12.6+0.34)
	RTU – PCNB	PCNB (24)
	Vitavax Extra – RTU	carboxin + imazalil + thiabendazole (16.7+1.2+1.5)
	Vitavax – Thiram - RTU	carboxin + thiram (10+10)
	Terra-Coat LT-2N	PCNB (23.7)
	Thiram – 42S	thiram (42)
	Thiram 50WP	thiram (50)
	Vitaflow 280	carboxin + thiram (14.9+13.2)
	Vitavax – PCNB	carboxin + PCNB (17+17)
	Vitavax – Thiram – Lindane	carboxin + thiram + lindane (14+12+8)
	Vitavax 200	carboxin + thiram (17+17)
	Vitavax 34	carboxin (34)
Novartis	Apron XL	metalaxyl (32.3)
	Dividend	difenoconazole (32.8)
	Dividend XL	difenoconazole + metalaxyl (16.5+1.38)
	Dividend XL RTA	difenoconazole + metalaxy (3.21+0.27)
	Maxim	fludioxonil (40.3)
	Mertect LSP	thiabendazole (30)
Trace Chemicals	Enhance	captan + carboxin (19.6+20)
	Enhance Plus	carboxin +maneb + lindane (20+35+18.75)
	Grain Guard	mancozeb (50)
	Grain Guard Plus	mancozeb + lindane (50+18.75)
	Vitavax – Thiram	carboxin + thiram (10+10)
Wilbur Ellis	Apron Flowable	metalaxyl (28.35)
	Apron TL	metalaxyl (11.5)
	Lorsban	chloropyrifos (30)
	Nuzone	imazalil (10)
	PCNB Flowable	pcnb (20)
	PCNB Seed Coat	pcnb (24)
Wilfarm	Agrosol O-F	thiram + thiabendazole (12.62+0.35)
	Granol NM	maneb + lindane (50+18.75)
	Granox plus	maneb + thiabendazole (50.0+2.0)
	Nu-Gro Isotox F	lindane + captan (25+12.7)

Lindane, Gaucho, Di-Syston and Lorsban are insecticides, all other compounds are fungicides.

Fungicide seed treatments and the diseases they control in Montana

	Common bunt wheat & covered smut barley	Loose smut		Dwarf smut (bunt) of winter wheat	Dry seed decay	Wet soil seedling rot caused by *Pythium*	Fusarium crown rot	Common root rot	Take-All	Bare patch caused by *Rhizoctonia*	Scab caused by *Fusarium*
		Wheat	Barley								
Apron XL® **Apron FL®** **Allegiance FL®**						E					
Baytan®	E	E	E				E	E	E	E	E
Dividend®	E	E		E	E		E	E	V	E	E
Dividend XL® **Dividend XL RTA®**	E	E		E	E	E	E	E	V	E	E
Captan **Maneb DBGreen®** **Mancozeb** **Thiram**	E				E	V					E
FloPro® **Nuzone®** **RR®**					E		E	E			E
Maxim®	Not yet tested in Montana										E
PCNB	E										E
Raxil Thiram®	E	E	E		E	V	E	E	V	E	E
Raxil XT & MD®	E	E	E		unknown	E	E	E	V	E	E
LSP & Mertect	E-Wheat only										
Vitavax 200® **Vitavax RTU®** **Vitavax Extra®**	E	E	E		E	V	V*	V*		E	E*

(E) = Effective disease control; ( ) = No disease control; (V) = May give some control; (*) Vitavax extra is more effective than Vitavax 200 due to addition of imazalil. Note: Not all treatment formulations are listed and many products contain more than one compound. For those products with more than one active ingredient, a close approximation of disease control can be obtained by adding the strengths of all ingredients together.

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